CLAIMS

We claim:

1. A planar optical device comprising:

a ridge-structured lower cladding layer of a first material having a first refractive index, the lower cladding layer comprising a planar portion and a ridge portion having a height H extending above the planar portion;

a core portion of a second material overlying the ridge portion, the core portion having a thickness T, the second material having a second refractive index greater than the first refractive index; and

a slab portion of the second material overlying the planar portion, the slab portion having a predominant thickness approximately equal to T, wherein the height H is greater than the thickness T.

2. The planar optical device of Claim 1, wherein the height H is greater than one and a half times the thickness T.

3. The planar optical device of Claim 1, further comprising an upper cladding layer overlying the core portion and the slab portion.

4. The planar optical device of Claim 1 wherein the core portion and the slab portion are not contiguous.

5. The planar optical device of Claim 1 further comprising a sidewall portion of the second material disposed on a sidewall of the ridge portion, wherein the core portion, the sidewall portion, and the slab portion form a continuous layer of the second material overlying the ridge-structured lower cladding layer.

6. The planar optical device of Claim 1 further comprising a sidewall portion disposed on a sidewall of the ridge portion, wherein the refractive index of a material of the sidewall portion is approximately the same as the first refractive index.

7. The planar optical device of Claim 6 wherein there is a smooth gradient in refractive index of the material at an interface between the core portion and the sidewall portion.

8. The planar optical device of Claim 1 wherein the second material comprises ions of a chemical species selected from the group consisting of rare earth ions, transition metal ions, and combinations thereof.

9. The planar optical device of Claim 1 wherein sides of the core portion make an angle with a horizontal top of the ridge portion that is between about 30 and about 60 degrees.

10. The planar optical device of Claim 1 wherein a sidewall of the ridge portion makes an angle with a horizontal plane that is between about 30 and about 60 degrees.

11. The planar optical device of Claim 1 wherein the core portion and the slab portion are deposited on the lower cladding layer by a physical deposition process wherein the lower cladding layer is positioned opposite a target comprising the second material and radiofrequency power is applied to the target in the presence of a gas such that a uniform plasma condition is created in the vicinity of the target, sputtering material from the target onto the lower cladding layer.

12. The planar optical device of Claim 11 wherein the core portion and the slab portion are deposited on the lower cladding layer by a physical deposition process further comprising applying radiofrequency power to the lower cladding layer.

13. The planar optical device of Claim 1 wherein the core portion and the slab portion are deposited on the lower cladding layer by a physical deposition process wherein the lower cladding layer is positioned opposite a target comprising a target material and pulsed direct current power is applied to the target in the presence of a background gas and a reactive gas, wherein reaction between the target material and the reactive gas results in deposition of the second material onto the lower cladding layer.

14. A process of fabricating a planar optical device, the process comprising:

forming a ridge structure in a layer of a first material having a first refractive index;

depositing a core layer over the ridge structure to form an intermediate structure, the core layer comprising a core material having a second refractive index;

depositing an upper cladding layer over the intermediate structure, the upper cladding layer comprising an upper cladding material having a third refractive index;

wherein the second refractive index is greater than the first refractive index and greater than the third refractive index, and wherein the process excludes a separate step of etching the core layer.

15. The process of Claim 14 wherein depositing the core layer is depositing the core layer by a physical vapor deposition process wherein the ridge structure is positioned opposite a target comprising the core material and radiofrequency power is applied to the target at a first frequency in the presence of a gas such that a uniform plasma condition is created in the vicinity of the target, sputtering material from the target onto the ridge structure.

16. The process of Claim 15 wherein depositing the core layer further comprises applying radiofrequency power to the ridge structure.

17. The process of Claim 14 wherein depositing the core layer further comprises applying radiofrequency power at a second frequency to the target, wherein the second frequency is smaller than the first frequency.

18. The process of Claim 14 wherein depositing the core layer is depositing the core layer by a physical vapor deposition process, wherein the ridge structure is positioned opposite a central region of a target, wherein the target comprises the central region and outer regions, the central region comprising the core material and the outer regions comprising material of lower refractive index than the core material, and wherein radiofrequency power is applied to the target in the presence of a gas such that a uniform plasma condition is created in the vicinity of the target, sputtering material from the target onto the ridge structure.

19. The process of Claim 18 wherein depositing the core layer further comprises applying radiofrequency power to the ridge structure.

20. The process of Claim 18 wherein the ridge structure comprises a ridge portion and a planar portion and the core layer comprises a core portion disposed overlying the ridge portion, a slab portion overlying the planar portion, and a sidewall portion disposed on a sidewall of the ridge portion, and wherein the sidewall portion comprises material of the outer regions of the target.

21. The process of Claim 14 wherein depositing the core layer is depositing the core layer by a physical vapor deposition process wherein the ridge structure is positioned opposite a target composed of a target material and pulsed direct current power is applied to the target in the presence of a background gas and a reactive gas, wherein reaction between the target material and the reactive gas results in deposition of the core material onto the ridge structure.

22. The process of Claim 21 wherein the target material comprises aluminum and the reactive gas comprises oxygen.

23. The process of Claim 22 wherein the target material further comprises a chemical species selected from the group consisting of silicon, rare earth elements, transition metal elements, and combinations thereof.

24. The process of Claim 14 wherein depositing the upper cladding layer is depositing the upper cladding layer by a physical vapor deposition process wherein the intermediate structure is positioned opposite a cladding target composed of the upper cladding material and radiofrequency power is applied to the cladding target in the presence of a gas such that a uniform plasma condition is created in the vicinity of the target, sputtering material from the cladding target onto the intermediate structure.

25. The process of Claim 24 wherein depositing the upper cladding layer further comprises applying radiofrequency power to the intermediate structure.

26. The process of Claim 14 wherein the layer of core material has an average surface roughness of less than about 3 nanometers.

27. The process of Claim 14 wherein forming the ridge structure in the layer of the first material comprises:

etching a ridge structure in a silicon wafer; and

exposing the etched silicon wafer to an oxidizing atmosphere under conditions wherein the silicon undergoes a reaction to convert the ridge structure to silica.

28. The process of Claim 14 wherein depositing the core layer over the ridge structure comprises:

depositing a layer of a core host material over the ridge structure;

implanting ions of chemical species selected from the group consisting of rare earth ions, transition metal ions, and combinations thereof into the core host material to form core material.

29. A method of fabricating a planar optical device, the method comprising:

forming a ridge structure in a layer of a first cladding material;

forming an intermediate structure by depositing core material overlying the ridge structure by a physical vapor deposition process in which, in the presence of a background gas, radiofrequency power is applied to a sputtering target comprising the core material and radiofrequency power is applied to the ridge structure; and

depositing an upper cladding layer over the intermediate structure, the upper cladding layer comprising a second cladding material, wherein

the refractive index of the core material is greater than the refractive index of the first cladding material and of the second cladding material, and wherein the process excludes a separate step of etching the core material.